Brüel & Kjær

2209

Impulse Precision Sound Level Meter

valid from serial no. 496282

037–0114

Service

Digitized by the Internet Archive
in 2025

https://archive.org/details/manualsplus_09866

2209

Impulse Precision Sound Level Meter

valid from serial no. 496282

037–0114

2209	page	date
Service Instruction	0–1	1.74
- -	0–2	1.74
Checking Procedure	1–1	5.72
- -	1–2	1.74
Power Supply	2–1	1.74
Meter Circuit	3–1	1.74
- -	3–2	5.72
- -	3–3	5.72
Output Amplifier	4–1	1.74
- -	4–2	5.72
Input Amplifier	5–1	1.74
- -	5–2	5.72
Weighting Network	6–1	5.72
Circuit Diagram and Parts List	7–1	1.74

B & K Sub-Assemblies			page	date
ZC	0007	Input Stage	1	1.74
ZE	0094	Output Amplifiers	1	1.74
ZE	0095	Meter Circuit	1	1.74
ZE	0102	Preamplifier, Filter	1	1.74
ZG	0071	Power Supply	1	1.74
ZL	0032	RMS Circuit	1	1.74

Trouble Shooting

If any faults should occur please check the instrument according to the procedure outlined below.

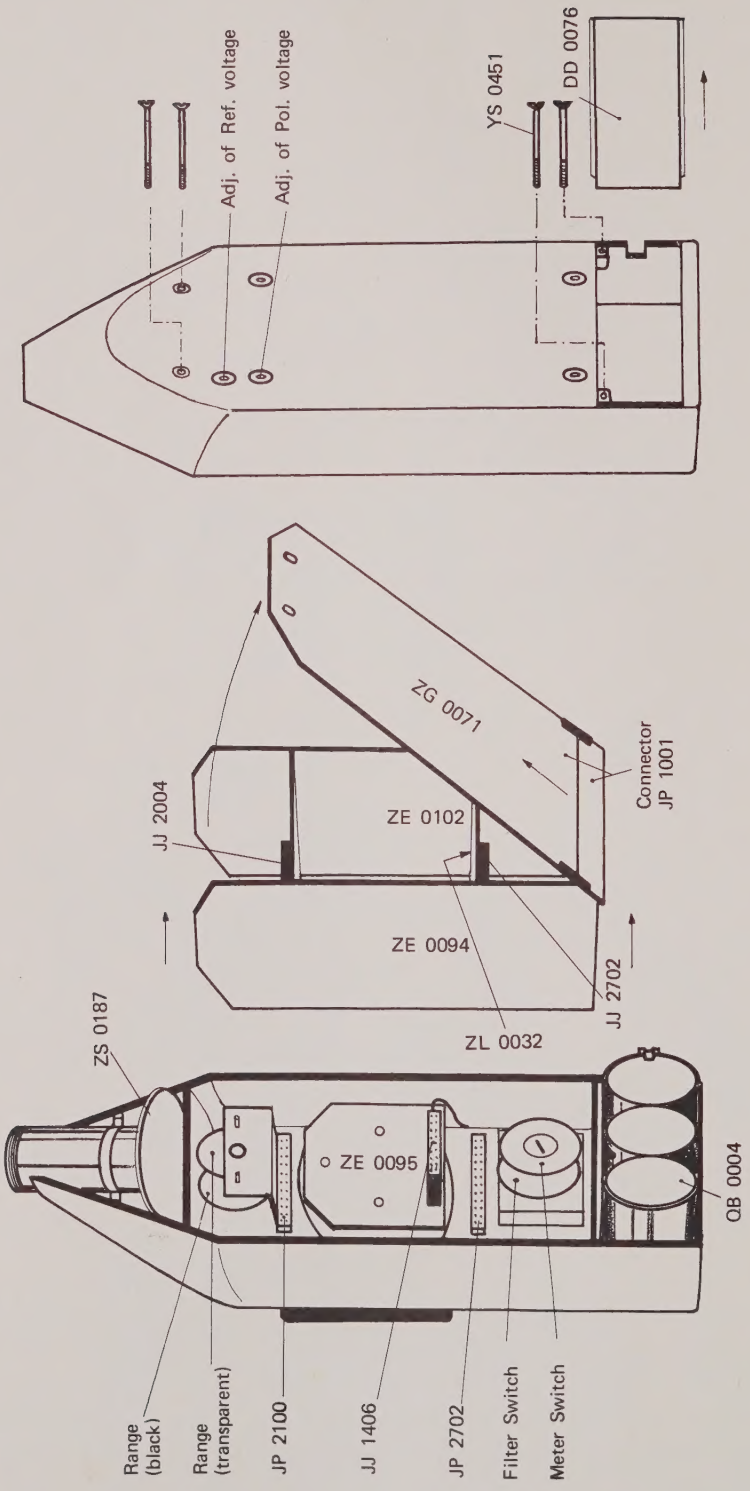
When a fault has been traced and corrected, the voltages and adjustments influenced by the correction must be rechecked. The complete instrument should then be tested according to the Checking Procedure to make sure that all basic functions are operative.

The tolerances given in these notes are intended for use as guide for adjustments.

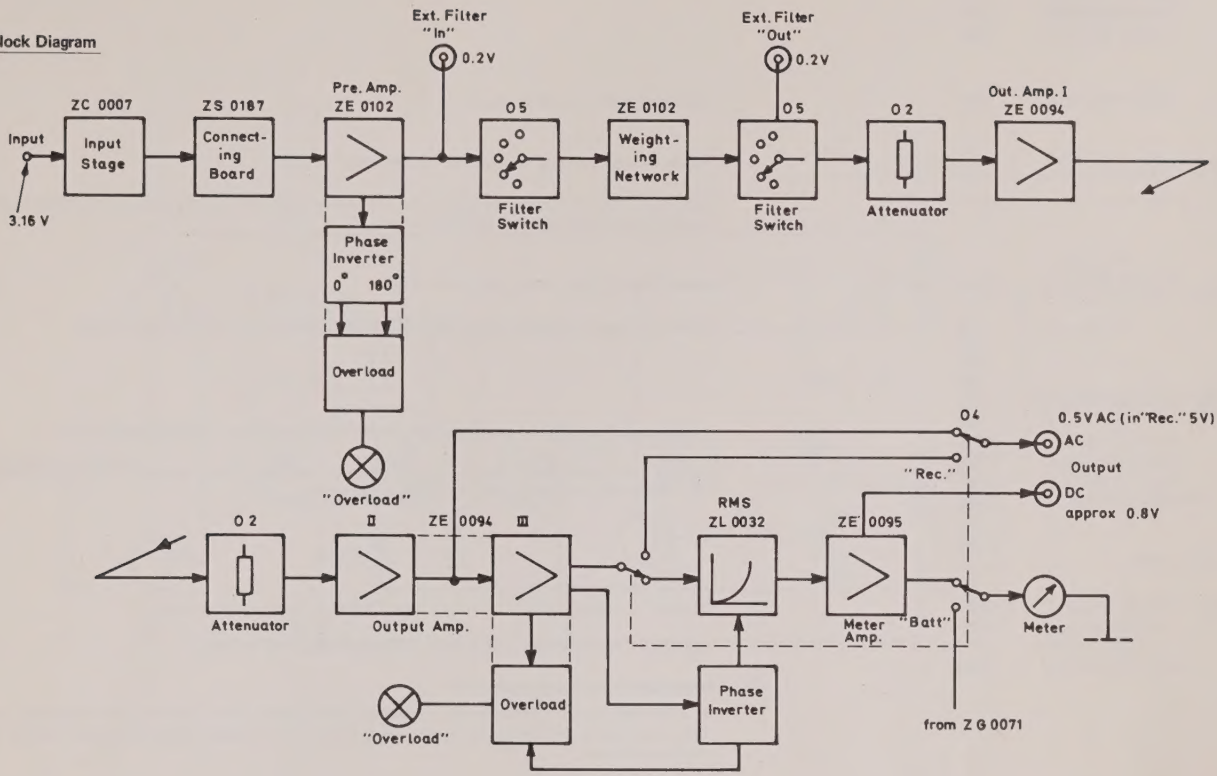
Before correcting any apparent deviation make sure that the measuring instrument has tolerances small enough not to affect the measurement.

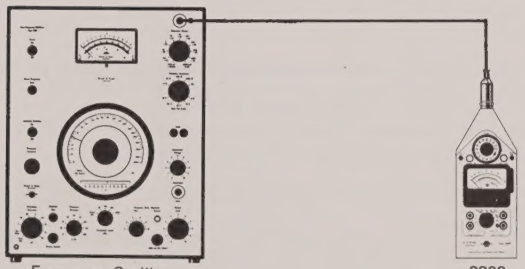
Spare Parts

Please state type and serial number of the Impulse Precision Sound Level Meter when ordering spare parts.


Adj. of Ref. voltage
Adj. of Pol. voltage
YS 0451
DD 0076
ZG 0071
Connector JP 1001
JJ 2004
ZE 0102
ZE 0094
JJ 2702
ZL 0032
ZS 0187
ZE 0095
OB 0004
Range (black)
Range (transparent)
JP 2100
JJ 1406
JP 2702
Filter Switch
Meter Switch

Block Diagram





1.1. Sensitivity

a. RANGE (black): "120"
RANGE (transp.): "120"
FILTER SWITCH: "Lin"
METER SWITCH: "Fast"

Input signal to front end of 2209: 3.16 V, 1000 Hz.

Adjust "Gain Adj." for 10 dB deflection (Adjustment range for "Gain Adj." approx. + 3, −10 dB).

Output voltage on "Ext. Filter In": 0.2 V
"DC Output": Approx. 1 V (measured with High Imp. Voltmeter)
"AC Output": Approx. 0.5 V
"AC Output": 5 V for METER SWITCH in "Rec"

b. FILTER SWITCH to "A-B-C-D"

Deflection for all ranges: 10 dB ± 0.1 dB.

1.2. Frequency Response

RANGE (black): "120"
RANGE (transp.): "120"
FILTER SWITCH: "Lin"
METER SWITCH: "Slow"

Frequency: 1000 Hz. Adjust the input voltage for a 9 dB deflection on 2209.
Vary the frequency from 2 Hz (or 10 Hz) – 70 kHz.
Meter deflection: 8–10 dB.

1.3. Meter Circuit

a. RANGE (black): "120"
RANGE (transp.): "120"
FILTER SWITCH: "Lin"
METER SWITCH: "Fast"

Frequency: 1000 Hz. Adjust the input voltage to give exactly 7 dB deflection on 2209.

b. METER SWITCH: "Peak"

Meter deflection: 10 dB ±0.5 dB.

c. METER SWITCH: "Imp. (Norm.)"

Adjust the input voltage to give a 8.6 dB deflection on 2209.

Disconnect the input signal by depressing "Oscillator Stop" on the Beat Frequency Oscillator and check that the deflection is 0 dB after 2-4 sec.

d. METER SWITCH: "Imp. (Hold)"

Connect input signal. Meter deflection: 9 dB.

Disconnect input signal and check that the deflection drops max. 0.5 dB in one minute.

1.4. Overload Indicators

RANGE (black): "110"
RANGE (transp.): "110"
FILTER SWITCH: "Lin"
METER SWITCH: "Fast"

Input signal: 7 V, 1000 Hz (corresponding to approx. 17 dB above full scale deflection).

Depress "Oscillator Stop" on the Beat Frequency Oscillator. When releasing "Oscillator Stop" both "Overload indicators" should light up a few times.

1.5. Noise

a. RANGE (black): "60"
RANGE (transp.): "10"
FILTER SWITHC: "A"
METER SWITCH: "Slow"

Connect an Input Adaptor JJ 2615 to Type 2209 and shortcircuit its input.

Notice! Make sure that the contact surfaces are clean and dustfree.

Meter deflection: Below 0 dB.

It is essential that the measurement is carried out in a quiet room. If the Sound Level Meter has been overloaded, the instrument must work for several minutes before the meter reaches its normal deflection.

b. RANGE (black): "60"
RANGE (transp.): "30"
FILTER SWITCH: "Lin"
METER SWITCH: "Fast"

Meter deflection: Below 0 dB

c. RANGE (black): "130"
RANGE (transp.): "80"
FILTER SWITCH: "Lin"
METER SWITCH: "Fast"

Remove Preamplifier ZC 0007, and measure the noise with open input.

Meter deflection: Max. 3 dB.

1.6. Sensitivity with Microphone

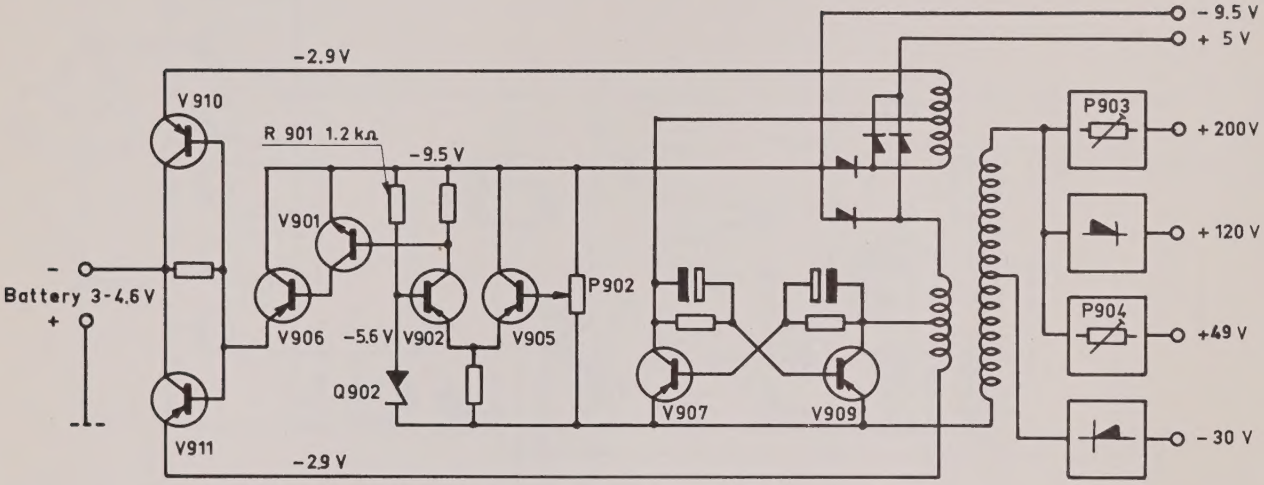
a. RANGE (black): "Ref"
RANGE (transp.): "Ref"
FILTER SWITCH: "Lin"
METER SWITCH: "Fast"

Adjust "Gain Adj." to the correct "Open circuit sensitivity" of the microphone.

b. RANGE (black) to "120"

Check the sensitivity with a Pistonphone Type 4220 or Sound Level Calibrator Type 4230. The meter deflection on 2209 should be equal to the Sound Pressure Level produced by the Pistonphone (Remember to correct for the actual static pressure).

Tolerance: ±0.2 dB.



Simplied Diagram of Power Supply ZG 0071

2.1. DC Voltages

METER SWITCH: "Batt"

Normal delay from switching "ON" till the instrument is stabilized is approx. 30 sec.

Check the DC-voltages according to the drawing to the printed circuits XC 0335 showed on ZG 0071.

If the –9.5 V is present and the Oscillator frequency is approx. 2 kHz the transformer can be regarded as an ordinary mains transformer with secondary voltages for the various circuits.

Small deviations in voltages can be adjusted by the potentiometers according to following scheme, whereby greater deviations are rather due to a fault which should be corrected before adjustment.

Consumption from the batteries in position "Ref" is approx. 210 mA.
"Ext. Filter" approx 195 mA.

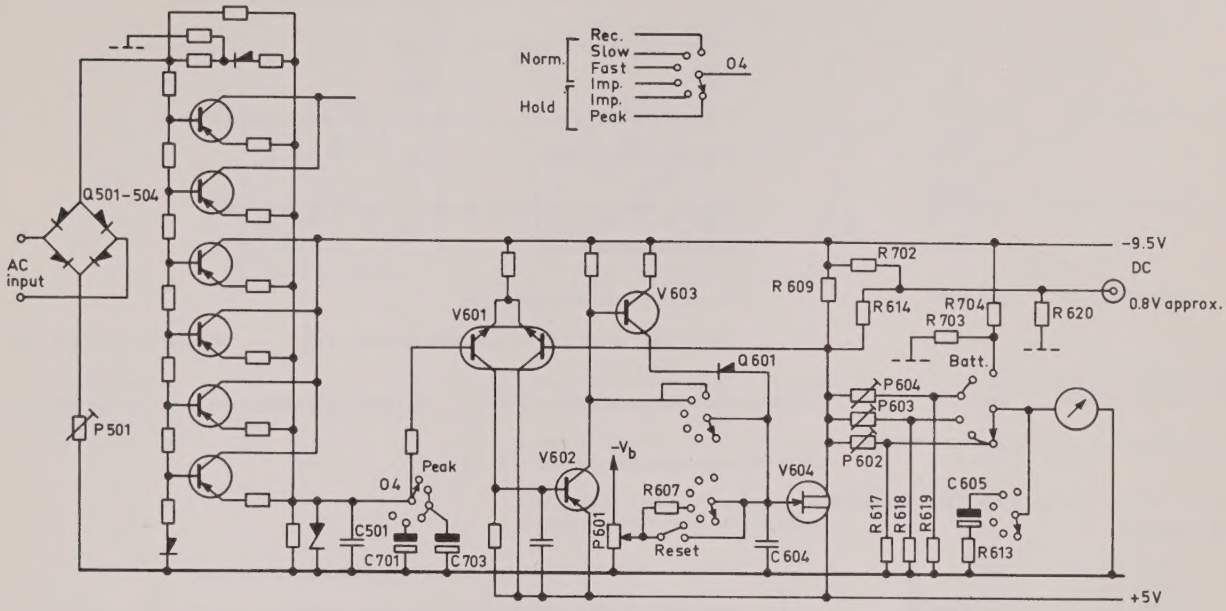
Adjustment of P 902: –9.5 V
P 903: 200 V (Measured with a high impedance voltmeter)
P 904: 49 V

The transistors V 910 and 911 are acting as battery regulators and the emitter voltage on both should be approx. –2.9 V.

If this voltage is –2.9 V and the DC converter is not oscillating disconnect the different loads one by one. If oscillation is impossible even unloaded the transformer or the converter transistors (V 907 and 909) are likely to be defective.

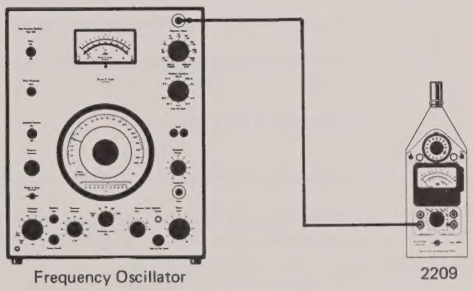
If the –2.9 V is not present examine transistor V 901, 902, 905 or 906 for faults as this is the regulating circuit for V 910 and 911.

Meter Circuit



Adjustment of:

	P501	RMS Balance
	P601	OV DC on V 604 source
	P602	Sensitivity "Hold"
	P603	Sensitivity "Impulse"
	P604	Sensitivity "Fast" and "Slow"
	R703	Battery Indication



3.1. Sensitivity Check

a.	RANGE (black):	"120"	Frequency 1000 Hz. Adjust the input voltage for 5 V_{RMS} on "AC output" socket.
	RANGE (transp.):	"120"	
	FILTER SWITCH:	"Ext. Filter"	
	METER SWITCH:	"Rec"	
b.	METER SWITCH:	"Fast"	Meter deflection: Exactly 10 dB.
c.	METER SWITCH:	"Imp. (Norm)"	Meter deflection: Exactly 10 dB.
d.	METER SWITCH:	"Imp. (Hold)"	Depress "Meter Reset" and release it again. Meter deflection: 10 dB.

3.2. Sensitivity Adjustment

a.	RANGE (black):	"120"	Frequency: 1000 Hz. Adjust the input voltage for 5 V_{RMS} on "AC Output" socket.
	RANGE (transp.):	"120"	
	FILTER SWITCH:	"Ext. Filter"	Check with an oscilloscope that the double rectified curves on the cathodes of Q 503 and Q 504
	METER SWITCH:	"Rec"	are equal. (ZL 0032)
b.	METER SWITCH:	"Fast"	If necessary adjust P 803. (ZE 0094) .

c. METER SWITCH: "Imp"

Disconnect input signal.
Unsolder one end of diode Q 601. Adjust P 601 (ZE 0095) for 0 V ± 5 mV on V 604 source.

Connect input signal.
Adjust P 603 for full scale deflection (10 dB).

d. METER SWITCH: "Fast"

When connecting input signal the deflection on 2209 should be exactly 10 dB.

If necessary adjust P 604.

e. METER SWITCH: "Imp. Hold"

Depress "Meter Reset" shortly and check the meter deflection: 10 dB.

If necessary adjust P 602.

f. METER SWITCH: "Peak Hold"

Adjust for a meter deflection: 10 dB.

Switch Meter Switch to "Fast" and check deflection: 7 dB.

g. METER SWITCH: "Batt"

With a battery voltage of 3.0 V – 3.1 V the meter should deflect to the lower mark of the battery scale.

If necessary change in value of R 703.

3.3. Overshoot

RANGE (black): "120"
RANGE (transp.): "120"
FILTER SWITCH: "Ext. Filter"
METER SWITCH: "Fast"

Frequency: 1000 Hz. Adjust input voltage for an 6 dB deflection on 2209.

Disconnect the input signal shortly by depressing the "Oscillator Stop" on the Frequency Oscillator and check the overshoot.

Overshoot: 0.1–1.1 dB for METER SWITCH in "Fast"
0.1–1.6 dB for METER SWITCH in "Slow"
max. 0.1 dB for METER SWITCH in "Imp. Hold"*)

*) Before "Oscillator Stop" is released for check of overshoot depress "Meter Reset" on 2209.

3.4. Meter Decay Time Constants

a. RANGE (black): "120"
RANGE (transp.): "120"
FILTER SWITCH: "Ext. Filter"
METER SWITCH: "Imp"

Frequency: 1000 Hz. Adjust the input voltage for an 8.6 dB deflection on 2209.

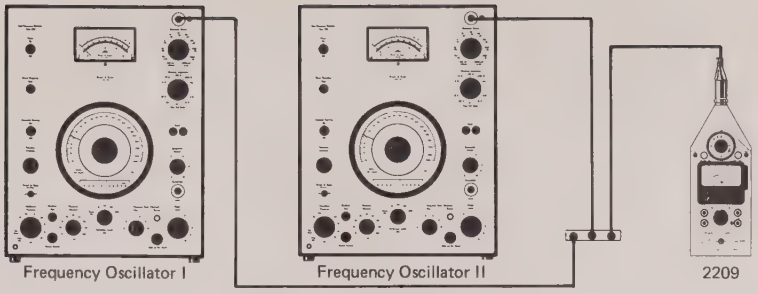
Disconnect the input signal and measure the time it takes for the pointer to decrease from 8.6 to 0 dB.

Tolerance: 3 ± 0.5 sec.

b. METER SWITCH: "Imp. Hold"

Adjust the input voltage for 10 dB deflection on 2209.

When the input signal is disconnected the meter deflection must not decrease more than 0.5 dB in one minute. (Only valid for 20°C and max. 60% relative humidity).



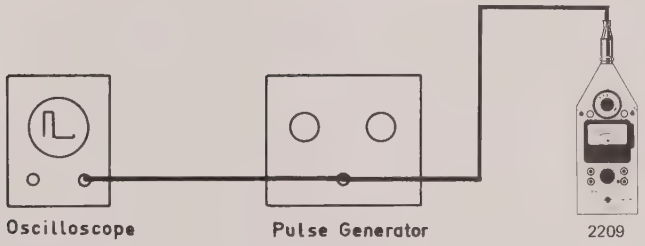
3.5. Check of RMS Rectifier

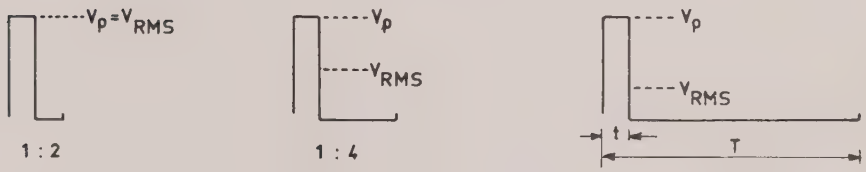
a. RANGE (black): "120"
RANGE (transp.): "120"
FILTER SWITCH: "Lin"
METER SWITCH: "Fast"

a. Depress "Oscillator Stop" on Frequency Oscillator II and adjust output of Frequency Oscillator I to give a 7 dB deflection on 2209.

b. Depress "Oscillator Stop" on Freuqency Oscillator I and adjust output of Frequency Oscillator II to give a 7 dB deflection on 2209.

With signal from both oscillators the deflection on 2209 should be 10 dB ±0.1 dB (evt. unlinearity of 2209 meter scale 0.2 dB).





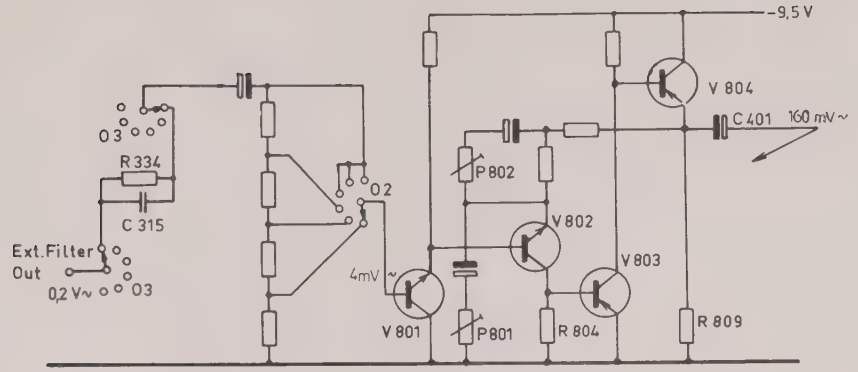
3.6. Check of RMS Indication

RANGE (black): "120 dB"
RANGE (transp.): "120 dB"
FILTER SWITCH: "Lin"
METER SWITCH: "Slow"

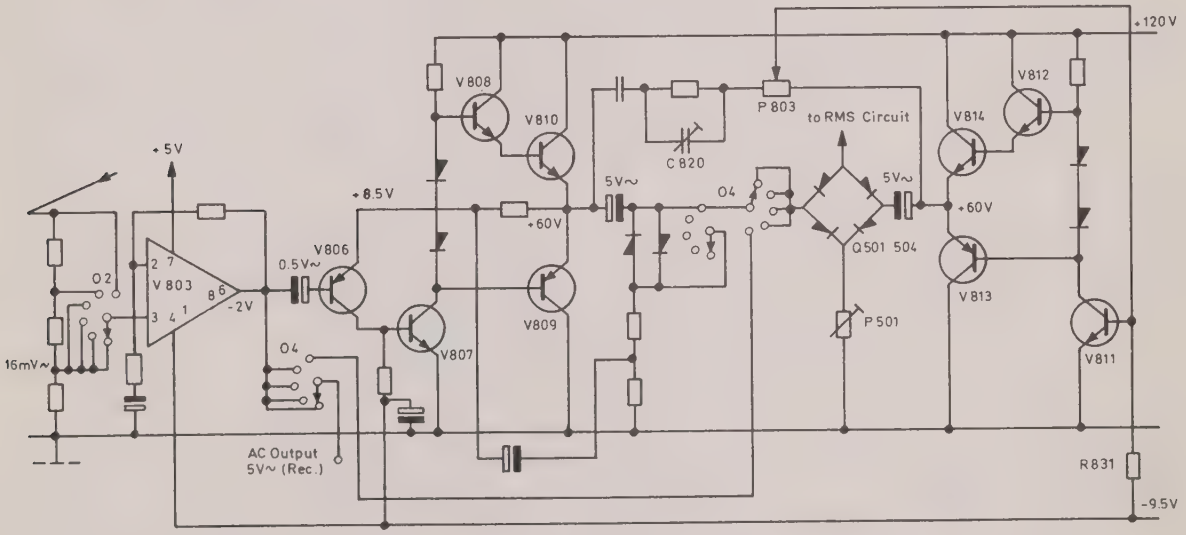
At a pulse duration of 0.1 m Sec. and a ratio of 1.2 the input voltage to 2209 should be adjusted to give a 0.2 dB deflection.

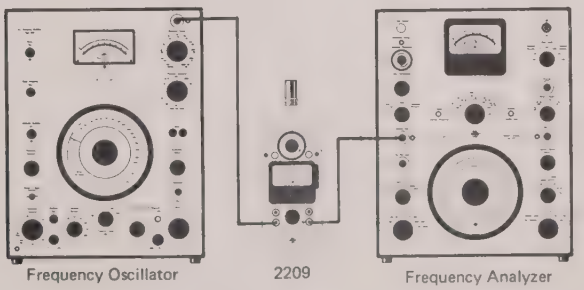
Check the indication for various pulse ratio according to following scheme.

RANGE (black)	$\frac{t}{T}$	$\frac{V_p}{V_{RMS}}$	Indication
120 dB	1 : 2	1	0.2 dB
110 dB	1 : 5	2	8.1 dB ±0.5 dB
110 dB	1 : 10	3	5.6 dB ±0.5 dB
110 dB	1 : 26	5	1.7 dB ±0.5 dB
100 dB	1 : 100	10	6 dB ±0.5 dB
100 dB	1 : 200	14	3 dB ±1 dB
100 dB	1 : 400	20	0 dB ±1 dB
100 dB	1 : 900	30	−3.5 dB ±1.5 dB



Adjustment of:
- P801 Sensitivity
- P802 Sensitivity at 2 Hz
- P803 Symmetric Output
- P501 RMS Balance





4.1. DC-Voltages

METER SWITCH: "Rec"

The DC-voltages across R 809 should be approx. 4 V negative.

If necessary change in value of R 804.

From midpoint R 826, R 827 to ground the voltage should be 57–63 V.

If necessary change in value of R 822 (56–120 kΩ).

From midpoint R 835, R 836 to ground the voltage should be 57–63 V.

If necessary change in value of R 831 (47–82 kΩ).

Valid from serial no. 372528

4.2. Sensitivity

a. RANGE (black): "120"
RANGE (transp.): "120"
FILTER SWITCH: "Ext. Filter"
METER SWITCH: "Rec"

Input signal: 0.2 V, 1000 Hz.

Output voltage on "AC Output" socket: 5 V.

If necessary adjust P 801 (ZE 0094).

b. METER SWITCH to "Fast"

Connect an Oscilloscope to Q 503, Q 504 (ZL 0032) and check that the two rectified curves are of the same height.

If necessary adjust P 803 (ZE 0094).

Change the signal frequency to 70 kHz and check the curves again.

If necessary adjust the height by C 820.

4.3. Attenuators

RANGE (black): "120"
RANGE (transp.): "120"
FILTER SWITCH: "Ext. Filter"
METER SWITCH: "Fast"

Frequency: 1000 Hz. Adjust the input voltage for an 8 dB deflection on 2209.

Check all attenuator steps of RANGE (transparent) by comparison to the attenuator of the Frequency Oscillator.

Tolerance: 0.2 dB (+ tolerance of Frequency Oscillator).

4.4. Output Impedance

RANGE (black): "120"
RANGE (transp.): "120"
METER SWITCH: "Rec"

Frequency: 1000 Hz. Adjust the input voltage for an output voltage of 5 V on "AC Output" socket.

Load the "AC Output" with a resistor of 10 kΩ and check that the output voltage is not decreasing more than 0.2 dB.

4.5. Overload

RANGE (black): "110"
RANGE (transp.): "110"
FILTER SWITCH: "Ext. Filter"
METER SWITCH: "Rec"

Input signal: 7 V ± 1 dB, 1000 Hz. (Corresponding to 17 dB above full scale deflection).

a. Disconnect the input signal by depressing "Oscillator Stop" on the Frequency Oscillator. When releasing "Oscillator Stop" the "Overload Output" should light up a few times.

b. Connect an Oscilloscope to "AC Output" socket and check that the signal is not limited.

4.6. Noise and Hum

a. RANGE (black): "120"
RANGE (transp.): "120"
FILTER SWITCH: "Ext. Filter"
METER SWITCH: "Rec"

Disconnect input signal to 2209. During measurement 2209 should be in its case and connected to ground.

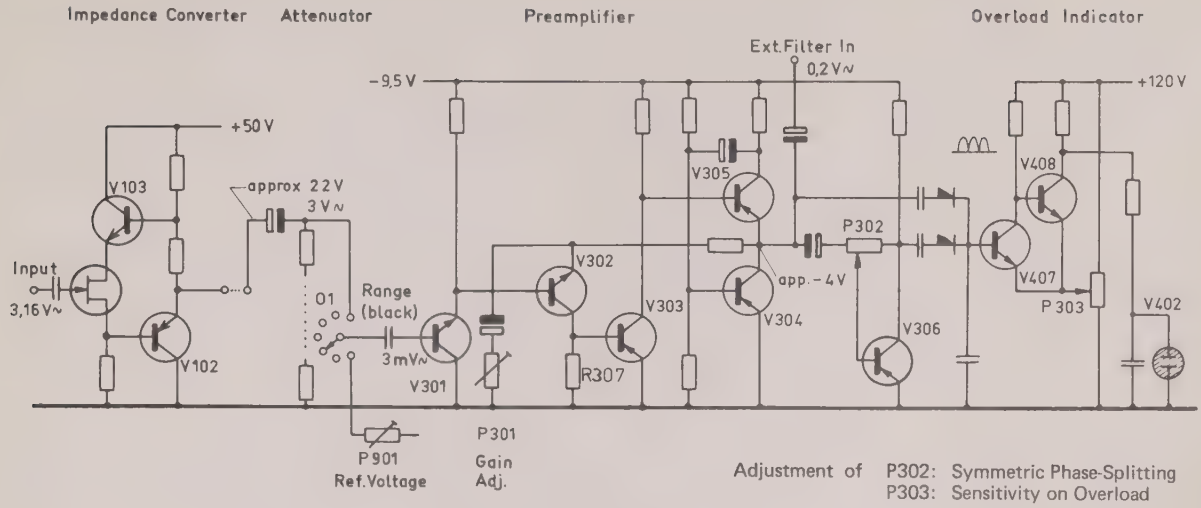
Hum from the DC converter (approx. 2 kHz) and 2nd and 3rd harmonic selectively measured max. 1.5 mV.

Noise (2–40 000 Hz): max. 14 mV.

b. RANGE (transp.) to "70"

Hum: max. 50 mV.

Noise: max. 300 mV.



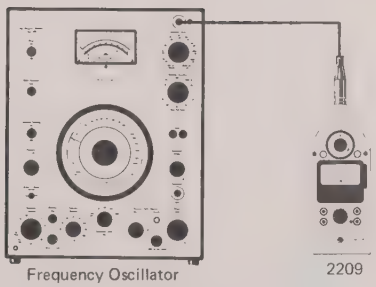
Simplified Diagram of Input Amplifier ZE 0014

5.1. DC-voltages

METER SWITCH: "Rec"

The midpoint of the output stage of the preamplifier (V 305_c, V 304_c) should be approx. 4 V negative. (XC 0331)

If necessary change in value of R 307 (5.6–10 kΩ).



Frequency Oscillator 2209

5.2. Sensitivity – Reference

a. RANGE (black): "120"
RANGE (transp.): "120"
FILTER SWITCH: "Lin"
METER SWITCH: "Fast"

Input signal: Exactly 2.24 V (10 V – 13 dB) at 1000 Hz.

Adjust P 301 "Gain Adj." for 7 dB deflection on 2209.

Adjustment range for P 301: The total red scale area.

b. RANGE (black) to "Ref"

Adjust reference voltage P 901 (XC 0335) for a deflection to 50 on the red scale mV per N/m^2 (corresponding 7 dB).

(CENTER OF INPUT CONNECTOR)

5.3. Frequency Response

RANGE (black): "120"
RANGE (transp.): "120"
FILTER SWITCH: "Lin"
METER SWITCH: "Fast"

a. Turn the screw for low frequency cut-off (on Connecting Board ZS 0187) fully clockwise.

Frequency: 1000 Hz. Adjust the input voltage for an 8 dB deflection on 2209.

Vary the frequency from 2 – 70 000 Hz.

Deflection on 2209: 7 – 9 dB (+ tolerance of Frequency Oscillator: 0.5 dB).

If necessary the low frequency response can be corrected by adjusting the interrelationship between P 801 and P 802 (ZE 0094) but in this case check item 4.2 again. The high frequency response can be corrected by changing the value of C 819 (0–10 pF).

Frequency response for Input Amplifier on "Ext. Filter In" socket.
5 – 70 000 Hz tolerance: 0 to –0.5 dB
2 – 5 Hz tolerance: 0 to 1 dB

b. Turn the screw fully counter clockwise and check that the lower limit frequency is changed from 2 Hz to approx. 15 Hz.

5.4. Attenuator

a. RANGE (black): "120"
RANGE (transp.): "120"
FILTER SWITCH: "Lin"
METER SWITCH: "Fast"

Frequency: 1000 Hz. Adjust the input voltage for an 8 dB deflection on 2209.

b. RANGE (black) through all positions

Check all attenuator steps of RANGE (black) by comparison to the attenuator of the Frequency Oscillator.

Tolerance: ±0.2 dB (+ tolerance of Frequency Oscillator: 0.2 dB).

5.5. Output Impedance

RANGE (black): "120"
RANGE (transp.): "120"
FILTER SWITCH: "Lin"
METER SWITCH: "Fast"

Frequency: 1000 Hz. Adjust the input voltage for a 10 dB deflection on 2209.

Connect a 500 Ω resistor across "Ext. Filter In" socket.

Meter deflection: 9.9– 10 dB.

5.6. Overload

RANGE (black): "110"
FILTER SWITCH: "Ext. Filter"

Frequency: 1000 Hz. Adjust the input voltage for an output voltage on "Ext. Filter In" socket of 1.4 V ±1 dB (corresponding to 17 dB above 0.2 V).

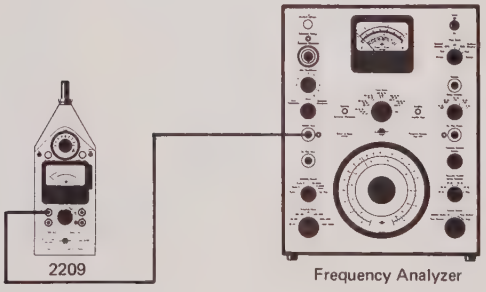
a. Check with an Oscilloscope that the output voltage is not visible distorted.

b. Check with an Oscilloscope that the rectified sine waves measured across C 310 are of the same height.

If necessary adjust P 302 (ZE 0102).

Disconnect the input signal by depressing "Oscillator Stop" on the Frequency Oscillator. When releasing it again the "Overload Input" should light up a few times.

If necessary adjust P 303 (ZE 0102).



5.7. Noise-Hum

a. RANGE (black): "Ref"
RANGE (transp.): "Ref"
FILTER SWITCH: "Lin"
METER SWITCH: "Fast"
03 in position: 15 Hz

Connect an Input Adaptor JJ 2615 to Type 2209 and shortcircuit its input.

The apparatus must be in its case and evt. connected to ground.

Adjust "Gain Adj." for a deflection to 50 mV per N/m^2.

b. RANGE (black) to "60"
RANGE (transp.) to "30"

Meter deflection: max. 0 dB.

c. FILTER SWITCH to "A"
RANGE (transp.) to "10"

Meter deflection: max. 0 dB.

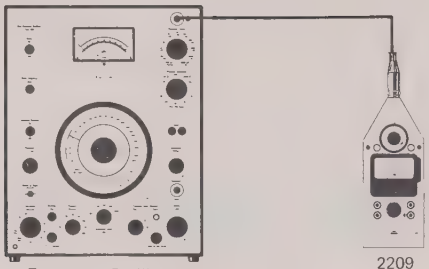
If the meter deflection exceeds the limit, check noise and hum for

Input Amplifier by measuring the output voltage on "Ext. Filter" socket. Check hum level measured selectively at the fundamental frequency of the DC-converter (approx. 2 kHz) and 2nd and 3rd harmonic.

Hum: max. 44 μV.

Noise: max. 200 μV (Measured with Frequency Analyzer (2107) in lin. 2 – 40 000 Hz).

Output Amplifier check item 4.6.



Frequency Oscillator

2209

6.1. 1000 Hz Level

a. RANGE (black): "120"
RANGE (transp.): "120"
FILTER SWITCH: "Lin"
METER SWITCH: "Fast"

Frequency: 1000 Hz. Adjust the input voltage to give exactly 8 dB deflection on 2209.

b. FILTER SWITCH in position "A-B-C-D"

Check that the deflection is 8 dB ±0.1 dB in all positions.

If the deflection exceeds the limits adjust

A	curve	by	P 304	(ZE 0102)
B	curve	by	P 305	-
C	curve	by	P 306	-
D	curve	by	P 307	-

6.2. Network Curves

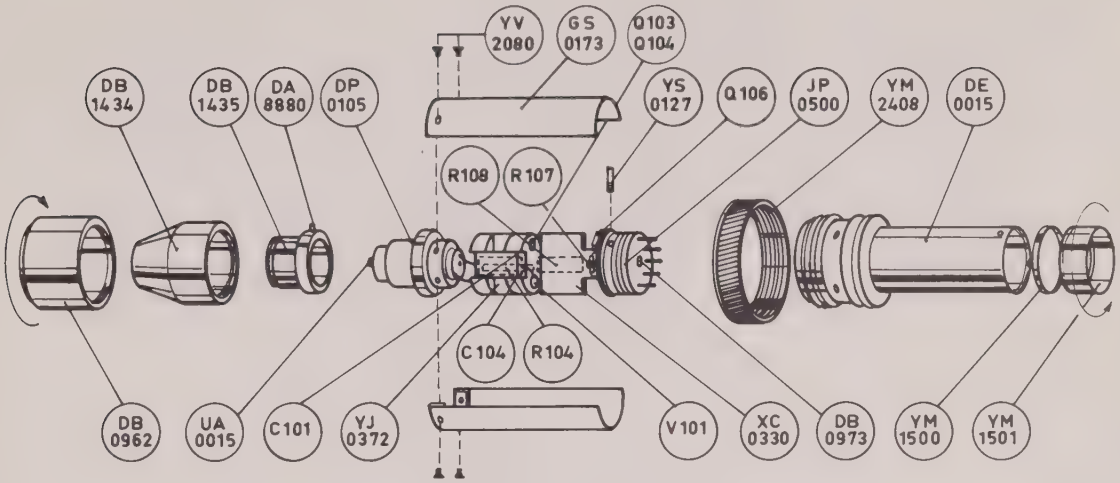
a. RANGE (black): "120"
RANGE (transp.): "120"
FILTER SWITCH: "Lin"
METER SWITCH: "Fast"

Frequency: 1000 Hz. Adjust the input voltage to give 8 dB deflection on 2209.

Check the filter curves according to following scheme.

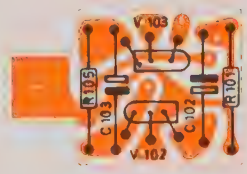
	Curve "A"		Curve "B"		Curve "C"		Curve "D"		
Hz	Defl. on 2209	RANGE (transp.)	Defl. on 2209	RANGE (transp.)	Defl. on 2209	RANGE (transp.)	Defl. on 2209	RANGE (transp.)	RANGE (black)
10			−2.2–1.8	90	1.7–5.7	110	−1.6–2.4	100	120
16	−0.7–3.3	70	−2.5–1.5	100	−2.5–1.5	120	2.5–65.	100	120
20	7.5–9.5	70	2.8–4.8	100	0.8–2.8	120	5.4–7.4	100	120
31.5	7.6–9.6	80	−0.1–1.9	110	4.0–6.0	120	−0.6–1.4	110	120
125	1.4–2.4	110	3.3–4.3	120	7.3–8.3	120	1.5–2.5	120	120
500	4.3–5.3	120	7.2–8.2	120	7.5–8.5	120	7.5–8.5	120	120
1k	7.9–8.1	120	7.9–8.1	120	7.9–8.1	120	7.9–8.1	120	120
2k	8.7–9.7	120	7.4–8.4	120	7.3–8.3	120	5.5–6.5	130	130
4k	8.5–9.5	120	6.8–7.8	120	6.7–7.7	120	8.4–9.4	130	130
8k	6.4–7.4	120	4.5–5.6	120	4.5–5.5	120	8.5–4.5	130	130
20k	7.7–9.7	110	5.9–7.9	110	5.8–7.8	110	−1.1–0.9	120	120

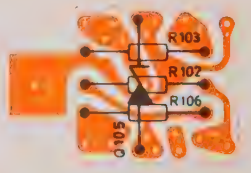
Layout Diagram and Parts List



Attention: Do not open the preamplifier ZC 0007 unless it is strictly necessary.

After repair it is necessary to clean all the parts with a mixture of 10% metylated alcohol and 90% Freon. When the circuit is completely dry, and clean, it should be coated with a mixture of 4% silicone oil (f. inst. Wacher WS 60) and 96% triclorethylene. After coating the circuit is dryed at a temperature of 120°C for one hour and immediately remounted.

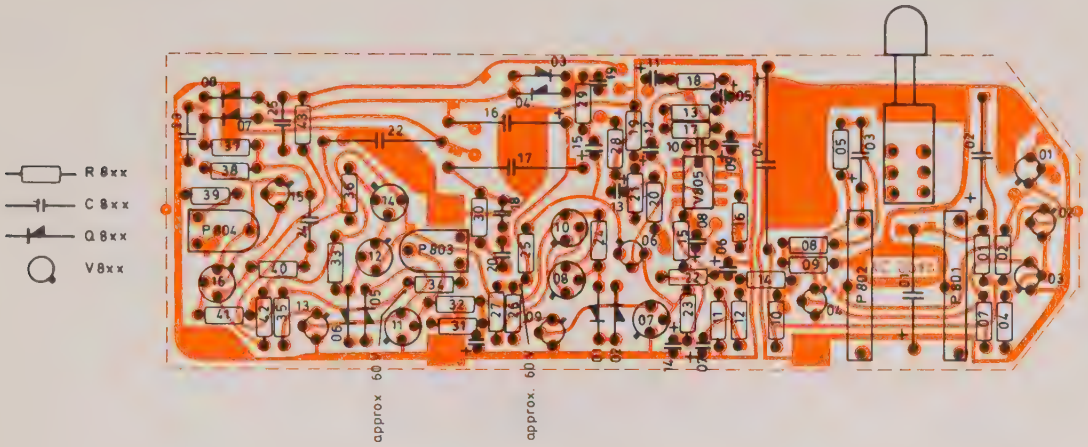




CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
C 101	Glass			1 nF/300 V	CG 0001
C 102,103	Tantalum			6.8 μF/ 6 V	CF 0030
C 104	Glass			300 pF/300 V	CG 0002
Q 103,104	Si. trans.	NPN		2 N 4292	VB 0533
Q 105	Zener	56 V/4.5 mA		1 N 732 A	QV 1327
Q 106	Si. trans.	150 V/0.3 A		BAX 16	QV 0217
R 101	Carbon	1/8 W	5%	8.2MΩ	RH 0910
R 102	-	-	10%	10MΩ	RH 0902
R 103	-	-	5%	180 kΩ	RA 0042
R 104	-	-	20%	1,8 GΩ	RH 0019
R 105	-	-	5%	3.3 kΩ	RA 0005
R 106	-	-	-	47 kΩ	RA 0011

CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
R 107	Metal	1/4 W	1%	22.1 kΩ	RF 4221
R 108	Carbon	-	10%	100MΩ	RH 0907
R 109	Metal	-	1%	60.4 Ω	RF 1604
R 110		-	-	2 kΩ	RF 3200
V 101	FET	N-channel		2 N 4867 A	VB 1037
V 102	Si. trans.	PNP		BCW 62 B	VB 0111
V 103		NPN		BCW 82 B	VB 0578
	Printed Circuit Board				XC 0330
	Protection Cap				DZ 9025

Layout Diagram and Parts List

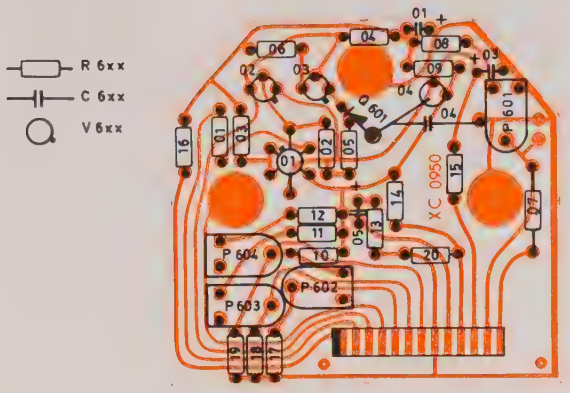


CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
C 801	Electrolytic			330 µF/ 10 V	CE 0211
C 802	Tantalum			220 µF/ 16 V	CF 0005
C 803	-			6.8 µF/ 6 V	CF 0006
C 804	Electrolytic			400 µF/ 10 V	CE 0305
C 805	Tantalum			100 µF/ 3 V	CF 0019
C 806	-			33 µF/ 10 V	CF 0034
C 807	-			6.8 µF/ 16 V	CF 0035
C 808	-			15 µF/ 16 V	CF 0028
C 809	-			33 µF/ 10 V	CF 0034
C 810	Ceramic			2.7 pF/400 V	CK 0270
C 811	Tantalum			100 µF/ 3 V	CF 0019
C 812	-			6.8 µF/ 16 V	CF 0035
C 813,814	-			2.2 µF/ 35 V	CF 0022
C 815	-			33 µF/ 10 V	CF 0034
C 816	Electrolytic			22 µF/100 V	CE 0616
C 817	Polyester			0.68 µF/100 V	CS 0342
C 818	Ceramic			6,8 pF/400 V	CK 0680
C 819	Ceramic			4.7 pF/400 V	CK 0470
C 820	Trimmer			3-8 pF	CV 0027
C 821	Tantalum			2,2 µF/ 35 V	CF 0022
C 822	Electrolytic			22 µF/100 V	CE 0616
C 823	Ceramic			1nF/500 V	CK 3100
C 824,825	Polyester			0.1 µF/250 V	CS 0402
P 801	Trimmer	Wire		500 Ω	PG 1502
P 802	-	-		5 kΩ	PG 2505
P 803	-	Cermet		47 kΩ	PG 3471
P 804	-	Carbon		25 kΩ	PG 3256
Q 801,802	Si.	150 V/300 mA		BAX 16	QV 0217
Q 803,804	-	100 V/225 mA		BAY 72	QV 0219
Q 805-808	-	150 V/300 mA		BAX 16	QV 0217
R 801	Carbon	1/4 W	5%	22 kΩ	RB 4220
R 802	-	-	-	270 kΩ	RB 5270
R 804	-	-	-	18 kΩ	RB 4180
R 805	Metal	-	1%	10 kΩ	RF 4100
R 807	Carbon	-	5%	47 kΩ	RB 4470
R 808	Metal	-	1%	10 kΩ	RF 4100
R 809	Carbon	-	5%	4.7 kΩ	RB 3470
R 810	-	-	-	220 Ω	RB 2220
R 811	-	-	-	270 kΩ	RB 5270
R 812	-	-	-	1MΩ	RB 6100
R 813	Metal	-	1%	3.24 kΩ	RF 3324

CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
R 814	Carbon	1/4 W	5%	10 Ω	RB 1100
R 815	-	-	-	82 kΩ	RB 4820
R 816	-	-	-	10 Ω	RB 1100
R 817	Metal	-	1%	100 kΩ	RF 5100
R 818	-	-	-	604 Ω	RF 2604
R 819	Carbon	-	5%	330 kΩ	RB 5330
R 820	-	-	-	1.5MΩ	RB 6150
R 821	-	-	-	150 kΩ	RB 5150
R 822	-	1/8 W	10%	91 kΩ	RA 0041
R 823	-	1/4 W	5%	6.8 kΩ	RB 3680
R 824	-	-	-	220 kΩ	RB 5220
R 825	-	-	-	470 kΩ	RB 5470
R 826,827	-	-	-	270 Ω	RB 2270
R 828	Metal	-	1%	8.45 kΩ	RF 3845
R 829	-	-	-	90.9 kΩ	RF 4909
R 830	Carbon	-	5%	330 kΩ	RB 5330
R 831	-	-	-	56 kΩ	RB 4560
R 832	-	-	-	10 kΩ	RB 4100
R 833	-	-	-	220 kΩ	RB 5220
R 834	-	-	-	330 kΩ	RB 5330
R 835,836	-	-	-	270 Ω	RB 2270
R 837	-	-	-	4.7 kΩ	RB 3470
R 838	-	-	-	2.2MΩ	RB 6220
R 839	-	-	-	180 kΩ	RB 5180
R 840	-	-	-	4.7MΩ	RB 6470
R 841	-	1/8 W	10%	3.9MΩ	RA 0039
R 842	-	1/4 W	5%	1.5MΩ	RB 6150
R 843	-	1/8 W	10%	3,9MΩ	RA 0039
V 806	Si. trans.	PNP		BC 179 B	VB 0100
V 807	-	NPN		BF 337	VB 0552
V 808	-	-		BF 337	VB 0545
V 809	-	PNP		2 N 4289	VB 0058
V 810	-	NPN		BF 337	VB 0545
V 811	-	-		BF 337	VB 0552
V 812	-	-		BF 337	VB 0545
V 813	-	PNP		2 N 4289	VB 0058
V 814	-	NPN		BF 337	VB 0545
V 815	-	-		BC 10913	VB 0047
V 816	-	-		BF 337	VB 0545
	Meter Reset Switch				NN 0019
	Printed Circuit Board				XC 0949

ZE 0094

Layout Diagram and Parts List



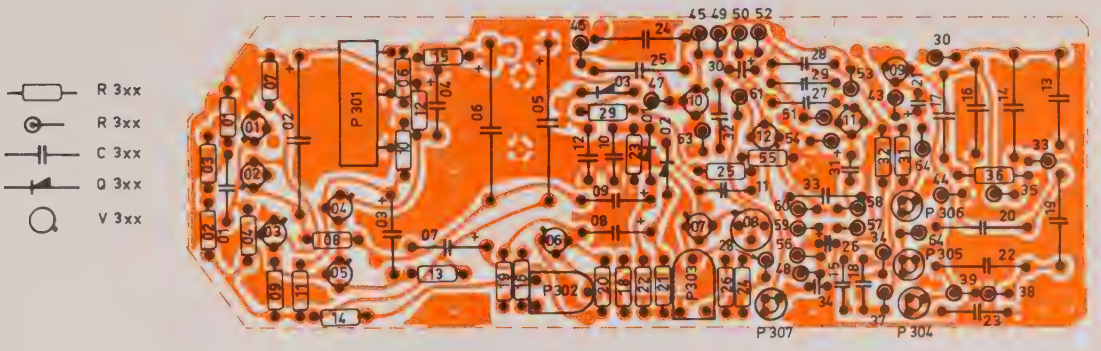
CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
C 601,603	Tantalum			33 µF/ 10 V	CF 0034
C 604	Polyester			0.15 µF/100 V	CS 0337
C 605	Tantalum			68 µF/ 3 V	CF 0011
P 601	Trimmer	Cermet		22 kΩ	PG 3221
P 602-604	-	-		10 kΩ	PG 3109
Q 601	Si. trans.	NPN		SF 115	VB 0533
R 601	Carbon	1/4 W	5%	100 Ω	RB 2100
R 602	Metal	-	1%	3.92 kΩ	RF 3392
R 603	-	-	-	18,2 kΩ	RF 4182
R 604	Carbon	-	5%	33 kΩ	RB 4330
R 605	-	-	-	220 kΩ	RB 5220
R 606	-	-	-	68 Ω	RB 1680
R 607	-	-	-	18MΩ	RH 0908
R 608	Metal	-	1%	100 kΩ	RF 5100
R 609	-	-	-	18.2 kΩ	RF 4182
R 610	-	-	-	24.9 kΩ	RF 4249

CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
R 611	Metal	1/4 W	1%	26.7 kΩ	RF 4267
R 612	-	-	-	29.4 kΩ	RF 4294
R 613	Carbon	-	5%	1 kΩ	RB 3100
R 614	-	-	-	68 kΩ	RB 4680
R 615,616	-	-	-	10 Ω	RB 1100
R 617	-	-	-	18 kΩ	RB 4180
R 618	-	-	-	33 kΩ	RB 4330
R 619	-	-	-	47 kΩ	RB 4470
R 620	-	-	-	39 kΩ	RB 4390
V 601	Si. trans.	dual NPN		BCY 87	VB 5302
V 602	-	PNP		2 N 2894	VB 0093
V 603	-	PNP		BC 179 B	VB 0100
V 604	FET	N-channel		E 102	VB 1053
	14-pin Connector				JP 1401
	Printed Circuit Board				XC 0950

Layout Diagram and Parts List

ZE 0102

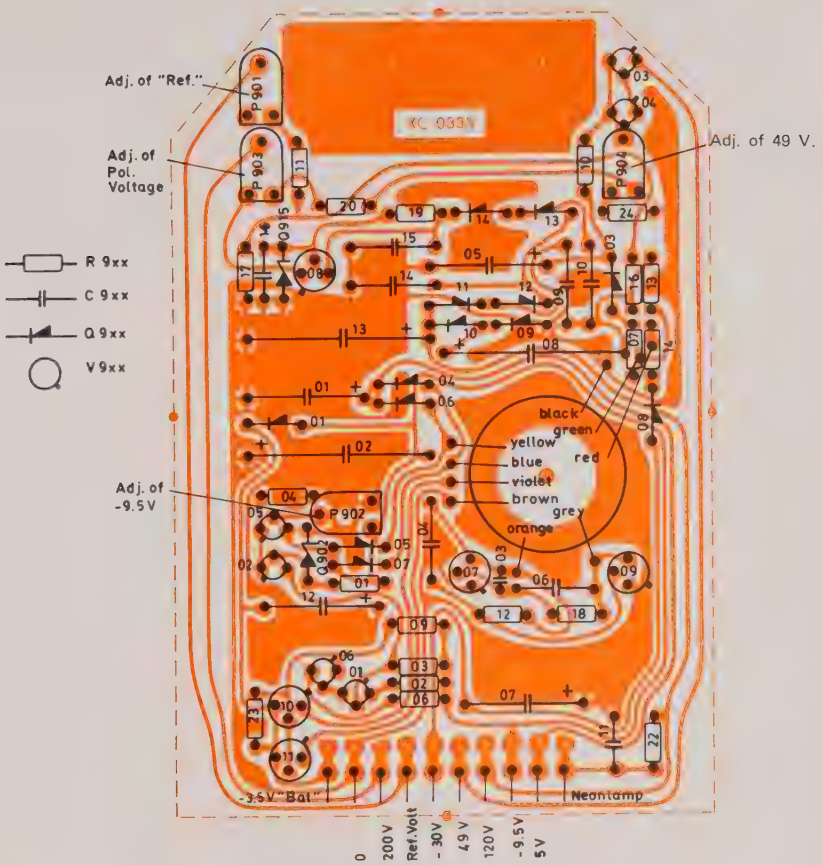
Preamplifier, Filter



CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
C 301	Tantalum			6.8 µF/ 6 V	CF 0006
C 302	Electrolytic			1000 µF/ 2.5 V	CE 0210
C 303	-			22 µF/ 25 V	CE 2002
C 304	-			47 µF/ 10 V	CE 0204
C 305,306	-			400 µF/ 10 V	CE 0305
C 307-309	-			47 µF/ 10 V	CE 0204
C 310	Polystyrene			400 pF/125 V	CT 1011
C 311,312	Polycarbonate			100 nF/250 V	CS 0402
C 313	Polystyrene			20 nF/ 63 V	CT 1125
C 314	Polycarbonate			0.47 µF/100 V	CS 0234
C 315	Ceramic			100 pF/400 V	CK 2100
C 316	Polystyrene			5.1 µF/ 63 V	CT 1124
C 317	Polycarbonate			47 nF/250 V	CS 0235
C 318	Ceramic			82 pF/400 V	CK 1820
C 319,320	Polystyrene			20 nF/ 63 V	CT 1125
C 321	Tantalum			6.8 µF/ 16 V	CF 0035
C 322	Polystyrene			5.1 nF/ 63 V	CT 1124
C 323	-			390pF/125 V	CT 1120
C 324,325	-			5.1 nF/ 63 V	CT 1124
C 326	Tantalum			33 µF/ 10 V	CF 0034
C 327	Polystyrene			820 pF/ 63 V	CT 1121
C 328,329	-			390 pF/125 V	CT 1120
C 330,331	Tantalum			6.8 µF/ 16 V	CE 0035
C 332	Polystyrene			2.4 nF/ 63 V	CT 1129
C 333	-			2 nF/ 63 V	CT 1123
C 334	Tantalum			33 µF/ 10 V	CF 0034
P 301	Trimmer	Wire		1 kΩ	PG 2106
P 302 303	-	Cermet		25 kΩ	PG 3256
P 304-307	-	-		25 kΩ	PG 3254
Q 301-303	Si.	15o V/300 mA		BAX 16	QV 0217
R 301	Carbon	1/4 W	5%	180 kΩ	RB 5180
R 302	-	-	-	2.2MΩ	RB 6220
R 303	-	-	-	1MΩ	RB 6100
R 304	-	-	-	270 kΩ	RB 5270
R 306	Metal	-	1%	182 Ω	RF 2182
R 307	Carbon	-	5%	6.8 kΩ	RB 3680
R 308	Metal	-	1%	22.1 kΩ	RF 4221
R 309	Carbon	-	5%	47 kΩ	RB 4470
R 310	-	-	-	33 kΩ	RB 4330
R 311	-	-	-	100 kΩ	RB 5100
R 312	-	-	-	680 Ω	RB 2680
R 313	-	-	-	470 Ω	RB 2470

CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
R 314	Carbon	1/4 W	5%	220 Ω	RB 2220
R 315	-	-	-	10 kΩ	RB 4100
R 316	-	-	-	100 kΩ	RB 5100
R 318	-	-	-	220 kΩ	RB 5220
R 319	-	-	-	100 kΩ	RB 5100
R 320	-	-	-	22 kΩ	RB 4220
R 321,322	-	-	-	47 kΩ	RB 4470
R 323	-	-	-	2.2MΩ	RB 6220
R 324,325	-	-	-	4.7MΩ	RB 6470
R 326	-	-	-	1.5MΩ	RB 6150
R 328	-	-	-	1.5MΩ	RB 6150
R 329	-	1/8 W	10%	3,9MΩ	RA 0039
R 330	Metal	1/4 W	1%	475 Ω	RF 2475
R 331,332	-	-	-	215 kΩ	RF 5215
R 333	-	-	-	18.7 kΩ	RF 4187
R 334	-	-	-	59 kΩ	RF 4590
R 335	-	-	-	2.26 kΩ	RF 3226
R 336	-	-	-	150 kΩ	RF 5150
R 337,338	-	-	-	59 kΩ	RF 4590
R 339	-	-	-	68,1kΩ	RF 4681
R 343	Carbon	-	5%	27 kΩ	RB 4270
R 344	Metal	-	1%	63.4 kΩ	RF 4634
R 345	-	-	-	11.8 kΩ	RF 4118
R 346	-	-	-	68.1 kΩ	RF 4681
R 347	-	-	-	37.4 kΩ	RF 4374
R 348	Carbon	-	5%	1 kΩ	RB 3100
R 349	Metal	-	1%	100 kΩ	RF 5100
R 350,351	-	-	-	82.5 kΩ	RF 4825
R 352	-	-	-	68.1 kΩ	RF 4681
R 353	-	-	-	100 kΩ	RF 5100
R 354	Carbon	-	5%	1MΩ	RB 6100
R 355	-	-	10%	4.7MΩ	RB 6470
R 356	-	-	5%	820 kΩ	RB 5820
R 357	Metal	-	1%	39.2 kΩ	RF 4392
R 358	-	-	-	11 kΩ	RF 4110
R 359,360	-	-	-	15 kΩ	RF 4150
R 361	-	-	-	75 kΩ	RF 4750
R 363	Carbon	-	5%	1 kΩ	RB 3100
R 364,365	Metal	-	1%	64,9 kΩ	RF 4649
V 301,302	Si. trans.	NPN		BC 174 B	VB 0537
V 303-306	-	PNP		BC 179 B	VB 0100
V 307	-	NPN		BC 109 B	VB 0047
V 308	-	NPN		BF 337	VB 0052
V 309-312	-	NPN		BC 109 B	VB 0545
	Printed Circuit Board				XC 0331

Layout Diagram and Parts List



CIRCUIT DIAGRAM REF.	COMPONENT TYPE			STOCK REF.
C 901	Electrolytic		220 µF/ 6.3 V	CE 0208
C 902	-		470 µF/ 10 V	CE 0305
C 903	Ceramic		2.2 nF/100 V	CK 9103
C 904	Electrolytic		10 µF/ 25 V	CE 0416
C 905	-		47 µF/ 63 V	CE 0509
C 906	-		10 µF/ 25 V	CE 0416
C 907	-		6.8 µF/ 40 V	CE 0453
C 908	-		22 µF/100 V	CE 0616
C 909	Polyester		47 nF/250 V	CS 0063
C 910	-		10 nF/400 V	CS 0101
C 911	-		100 nF/250 V	CS 0402
C 912	Electrolytic		100 µF/6.3 V	CE 0207
C 913	-		33 µF/160 V	CE 2038
C 914	Polyester		47 nF/250 V	CS 0063
C 915	Polyester		10 nF/400 V	CS 0101
C 916	-		47 nF/250 V	CS 0401
P 901, 902	Trimmer	Cermet	100 kΩ	PG 4108
P 903	-	Carbon	2MΩ	PG 5202
P 904	-	-	1MΩ	PG 5102
Q 901	Si.		150 V/300 mA	BAX 16	QV 0217
Q 902	Zener		5-6.2 V/ 5 mA	ZG 5,6	QV 1105
Q 903	Si.		150 V/300 mA	BAX 16	QV 0217
Q 904-907	Ge.		115 V/150 mA	OA 85	QV 0085
Q 908-914	Si.		150 V/300 mA	BAX 16	QV 0217
Q 915	Zener		220 V/ 15 mA	MZ 22 BA	QV 1326

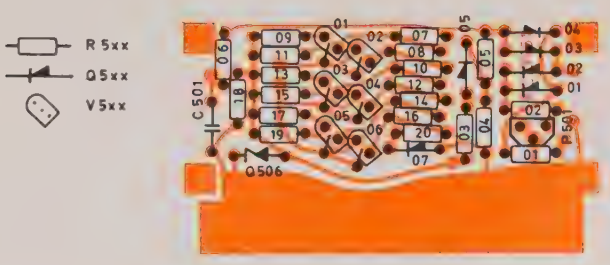
CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
R 901	Carbon	1/4 W	5%	1.2 kΩ	RB 3120
R 902	-	-	-	220 Ω	RB 2220
R 903	-	-	-	5.6 kΩ	RB 3560
R 904	-	-	-	15 kΩ	RB 4150
R 906,907	-	-	-	1 kΩ	RB 3100
R 909	-	-	-	10 kΩ	RB 4100
R 910	-	-	-	1 kΩ	RB 3100
R 911	-	-	-	270 kΩ	RB 5270
R 912	-	-	-	1 kΩ	RB 3100
R 913,914	-	-	-	470 Ω	RB 2470
R 916	-	-	-	1MΩ	RB 6100
R 917	-	-	-	3.9 kΩ	RB 3390
R 918	-	-	-	1 kΩ	RB 3100
R 919	-	1/8 W	10%	10MΩ	RA 0025
R 920	-	1/4 W	5%	4.7MΩ	RB 6470
R 922	-	1/8 W	10%	10MΩ	RA 0025
R 923	-	1/4 W	5%	10 kΩ	RB 4100
R 924	-	-	-	1.5MΩ	RB 6150
V 901	Si. trans.	NPN		BC 109	VB 0047
V 902	-	PNP		BC 179	VB 0100
V 903,904	-	NPN		BC 109	VB 0047
V 905,906	-	PNP		BC 179	VB 0100
V 907	Ge. trans.	PNP		ASY 80	VB 0069
V 908	Si. trans.	NPN		BF 337	VB 0545
V 909-911	Ge. trans.	PNP		ASY 80	VB 0069
	Converter Transformer				LB 0630
	10-pin Connector				JP 1001
	Printed Circuit Board				XC 0335

ZG 0071

Layout Diagram and Parts List

ZL 0032

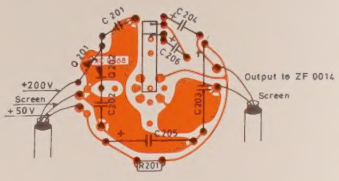
RMS Circuit



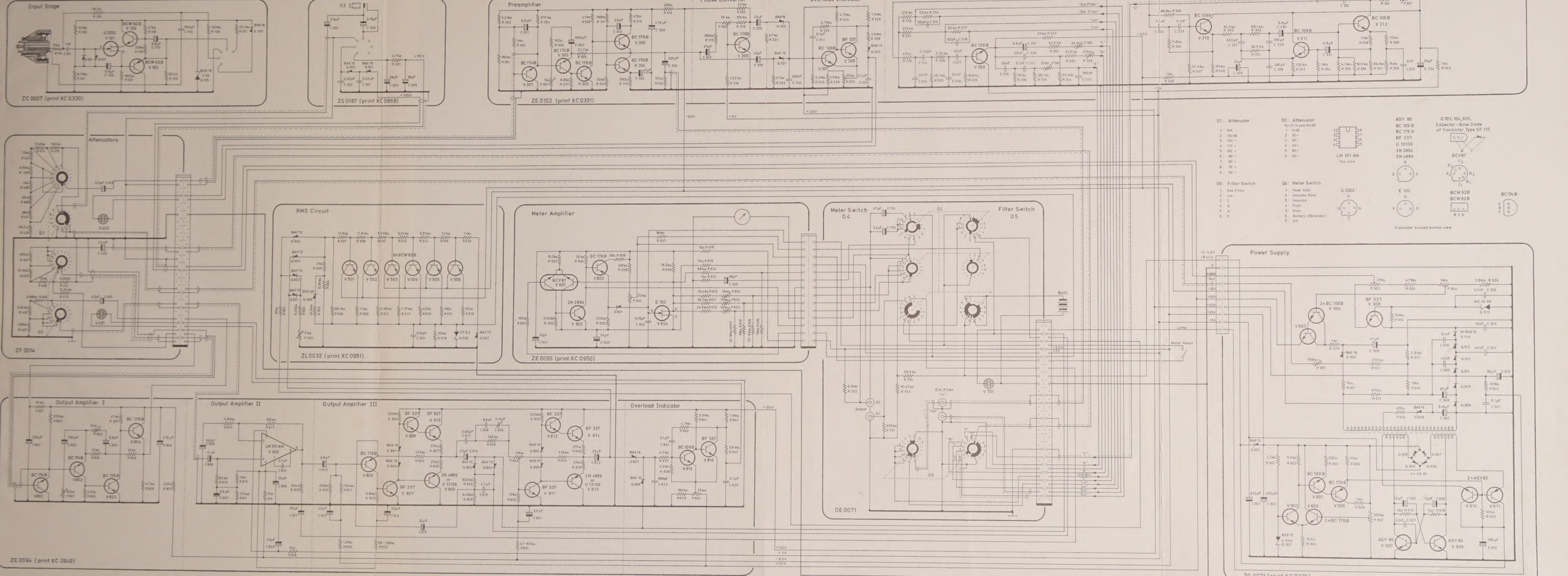
CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
C 501	Polystyrene			510 pF/ 63 V	CT 1135
P 501	Trimmer	Carbon		2 kΩ	PG 2206
Q 501-504	Si.			100 V/200 mA BAY 72	QV 0219
Q 505	Si.			15 V/ 30 mA SFD 121	QV 0100
Q 506	Zener			6.2 V/ 35 mA ZP 6.2	QV 1334
Q 507	Si.			100 V/220 mA BAY 72	QV 0219
V 501-506	Silicon	PNP		BCW 62 B	VB 0049
R 501	Metal	1/4 W	1%	100 Ω	RF 2100
R 502	-	-	-	5.23 kΩ	RF 3523
R 503	-	-	-	24.9 kΩ	RF 4249
R 504	-	-	-	8.06 kΩ	RF 3806
R 505	-	-	-	2 kΩ	RF 3200
R 506	-	-	-	68.1 kΩ	RF 4681

CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
R 507	Metal	1/4 W	1%	31.6 kΩ	RF 4316
R 508	-	-	-	11.8 kΩ	RF 4118
R 509	-	-	-	11 kΩ	RF 4110
R 510	-	-	-	5.23 kΩ	RF 3523
R 511	-	-	-	3.16 kΩ	RF 3316
R 512	-	-	-	3.01 kΩ	RF 3301
R 513	-	-	-	1.27 kΩ	RF 3127
R 514	-	-	-	2.21 kΩ	RF 3221
R 515	-	-	-	422 kΩ	RF 2422
R 516	-	-	-	1.1 kΩ	RF 3110
R 517	-	-	-	100 Ω	RF 2100
R 518	-	-	-	20 kΩ	RF 4200
R 519	-	-	-	15.4 Ω	RF 1154
R 520	-	-	-	1.1 kΩ	RF 3110
	Printed Circuit Board				XC 0951

CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
C 201,202	Polyester			0.22 µF/250 V	CS 0405
C 203	Electrolytic			68µF/ 63 V	CE 0513
C 204	Tantalum			3.9 µF/ 35 V	CF 0015
C 205	Electrolytic			68 µF/ 63 V	CE 0513
C 206	Tantalum			0.15 µF/ 35 V	CF 0033
C 401	-			47 µF/ 6.3 V	CF 0023
C 402,403	-			2.2 µF/ 35 V	CF 0022
C 701	-			47 µF/ 6 V	CF 0017
C 703	-			3.3 µF/ 15 V	CF 0025
	Battery Cover				DD 0076
	Carrying Strap				DH 0049
					+ YS 0418
	Spring for Scales				OL 3053
	Cabinet Top Half				FA 0409
	Cabinet Bottom Half				FB 0197
	Moving Coil Instrument				IM 0008
	Coax Socket				JJ 0006
	14-pin Connector				JJ 1406
	20-pin -				JJ 2005
	27-pin -				JJ 2702
	10-pin –				JP 1001
	21-pin -				JP 2100
	27-pin -				JP 2702
	Socket for ZC 0007				JY 0009
	Meter Reset Switch				NN 0019
O 3	Switch				OD 0207
					OD 0208
O 1,2	Attenuator Switch				OR 2204
O 4,5	Meter and Filter Switch				OG 3003
	Dry Cell 1.5 V				QB 0004
Q 201,202	Si. diode	BAX 16		150 V/300 mA	QV 0217
R 201	Carbon	1/4 W	5%	4.7 kΩ	RB 3470
R 401	Metal	-	1%	3.32 kΩ	RF 3332
R 402	-	-	-	10 kΩ	RF 4100
R 403	-	-	-	31.6 kΩ	RF 4316
R 404	-	-	-	100 kΩ	RF 5100
R 405	-	-	-	1 kΩ	RF 3100
R 406	-	-	-	3.16 kΩ	RF 3316
R 407	-	-	-	1.5 kΩ	RF 3150
R 408	-	-	-	10 kΩ	RF 4100
R 409	-	-	-	316 Ω	RF 2316
R 410	-	-	-	10 kΩ	RF 4100
R 411	-	-	-	100 Ω	RF 2100
R 412	-	-	-	31.6 kΩ	RF 4316
R 413,414	-	-	-	39.2 kΩ	RF 4392
R 413,414	-	-	-	12.1 kΩ	RF 4121
R 415	Carbon	-	5%	10 kΩ	RB 4100
R 415	Metal	-	1%	46.6 Ω	RF 1464
R 416	-	-	-	100 kΩ	RF 5100
R 701	Carbon	-	5%	220 kΩ	RB 5220
R 702	-	-	-	6.8MΩ	RH 0904
R 703	Metal	-	-	15-47 kΩ	
R 704	-	-	1%	69.8 kΩ	RF 4698
	Knob for Filter Switch				SN 0826
	Knob for Attenuator, black				SN 1019
					+ DB 0345
					+ YM 1305
					+ DL 3053
	Meter				IM 0052



CIRCUIT DIAGRAM REF.	COMPONENT TYPE		STOCK REF.
	Knob for Attenuator, transp.		SN 1020
			+ DB 0965
			+ DB 0346
			+ YM 0906
			+ YS 1700
	Knob for Meter Switch		SN 1021
	10 – 130 dB	1 A	
	20 – 140 dB	1 B	SA 0012
	30 – 140 dB	2 A	
	40 – (160 dB)	2 B	SA 013
	50 – 160 dB	3 A	
	10 µV – 10 V	3 B	SA 0014
	$3 \cdot 10^{-1} - 3 \cdot 10^{5}$	4 A	
	$10^{-1} - 10^{5}$	4 B	SA 0015
	$3 \cdot 10^{-2} - 3 \cdot 10^{4}$	5 A	
	$10^{-2} - 10^{4}$	5 B	SA 0016
	$3 \cdot 10^{-3} - 3 \cdot 10^{3}$	6 A	
	$10^{-3} - 10^{3}$	6 B	SA 0017
	$3 \cdot 10^{-4} - 3 \cdot 10^{2}$	7 A	
	$10^{-4} - 10^{2}$	7 B	SA 0018
	$3 \cdot 10^{-5} - 30$	8 A	
	$10^{-5} - 10$	8 B	SA 0019
	$3 \cdot 10^{-6} - 3$	9 A	
	$10^{-6} - 1$	9 B	SA 0020
	$3 \cdot 10^{-7} - 3 \cdot 10^{-1}$	10 A	
	$10^{-7} - 10^{-1}$	10 B	SA 0021
	Scale, blank		SA 0024
V 401,402	Neon lamp		VS 8011
V 701			VS 0013
05,04	Meter, Filter Switch		OE 0071
	Input Stage		ZC 0007
	Output Amplifiers		ZE 0094
	Meter Circuit		ZE 0095
	Preamplifier, Filter		ZE 0102
	Attenuators		ZF 0014
	Power Supply		ZG 0071
	RMS Circuit		ZL 0032
		p.c. board	with comp.
	Input Connector	XC 0868	ZS 0187


Input Stage
ZC 0007 (print XC 0330)
ZS 0187 (print XC 0868)
Preamplifier
ZE 0102 (print XC 0331)
Phase Converter
Overload Indicator
Attenuators
ZF 0014
RMS Circuit
ZL 0032 (print XC 0951)
Meter Amplifier
ZE 0095 (print XC 0950)
Meter Switch 04
Filter Switch 05
OE 0071
Power Supply
ZG 0071 (print XC 0325)
Output Amplifier I
Output Amplifier II
Output Amplifier III
Overload Indicator
ZE 0094 (print XC 0949)
01: Attenuator
02: Attenuator
LM 301 AN
Top view
ASY 80
BC 109 B
BC 179 B
BF 337
U 13106
2N 2894
2N 4889
BCY 87
Q 103, 104, 601, Collector-Base Diode of Transistor Type SF 115
05: Filter Switch
04: Meter Switch
U 2002
E 102
BCW 62B
BCW 62B
BC174B
Transistor sockets bottom view

MP MASTER
MA21864